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Description

NITRIDE LIGHT-EMITTING DEVICE HAVING AN ADHESIVE REFLECTING LAYER

BACKGROUND OF INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a light-emitting component, and more particularly, to a nitride light-emitting component with an adhesive reflecting layer.

[0003] 2. Description of the Prior Art

[0004] The applications of light-emitting diodes are extensive and include optical display devices, traffic signals, data storing devices, communication devices, illumination devices, and medical apparatuses. As such, it is important to increase the brightness of light-emitting diodes.

[0005] Traditionally, an oxide-reflecting layer is deposited onto a transparent substrate to increase brightness of a nitride light-emitting device. The oxide-reflecting layer reflects

light emitted from a light-emitting stack layer to increase overall brightness. However, the oxide-reflecting layer only reflects light of perpendicular incidence and specific wavelength. In addition, during the manufacturing process, the oxide-reflecting layer can be stripped by external force. Therefore, the reflecting efficiency of the oxide-reflecting layer is low.

[0006] Moreover, a metal layer is deposited on the transparent substrate to reflect light emitted from the light-emitting stack layer. The reflecting efficiency of the metal layer is better than the oxide-reflecting layer, but the adhesive force between the substrate and the metal is weak. In order to increase the adhesive force, a titanium or chromium layer is formed between the substrate and the metal layer. However, the titanium or chromium layer absorbs light so as to decrease the overall reflecting efficiency.

SUMMARY OF INVENTION

[0007] It is therefore a primary objective of the claimed invention to provide a transparent adhesive layer between the metal layer and the light-emitting layer to solve the above-mentioned problem. Light from the light-emitting stack layer penetrates the transparent adhesive layer and is re-

flected by the metal layer. In addition, reaction layers are formed on an upper surface of the transparent adhesive layer to contact the nitride light-emitting layer and on a lower surface of the transparent adhesive layer to contact the metal layer. The reaction layers react with the transparent adhesive layer to increase the adhesive force and-provideresistance to being stripped. Moreover, a metal heat sink is plated on another surface of the metal layer so as to increase the brightness of the light-emitting device.

[0008] According to the claimed invention, a nitride light-emitting device having an adhesive reflecting layer comprising a first substrate, a metal reflecting layer formed on the first substrate, a first reaction layer formed on the metal reflecting layer, a transparent adhesive layer formed on the first reaction layer, a second reaction layer formed on the transparent adhesive layer, a second substrate formed on the second reaction layer, a nitride first contact layer formed on the second substrate, an upper surface of the nitride first contact layer having a first section and a second section, a nitride first cladding layer formed on the first section, a nitride light-emitting layer formed on the nitride first cladding layer, a nitride second cladding layer

formed on the nitride light-emitting layer, a nitride second contact layer formed on the nitride second cladding layer, a transparent conductive layer formed on the nitride second contact layer, a first electrode formed on the transparent conductive layer, and a second electrode formed on the second section.

[0009] The first substrate comprises at least one material selected from a material group consisting of silicon, GaAs, glass, quartz, GaP, GaAsP, AlGaAs, and metal. The second substrate comprises at least one material selected from a material group consisting of Al_2O_3, SiC, ZnO, and GaN. The transparent adhesive layer comprises at least one material selected from a material group consisting of PI, BCB, and PFCB. The first reaction layer comprises at least one material selected from a material group consisting of SiNx, Ti, and Cr. The second reaction layer comprises at least one material selected from a material group consisting of SiNx, Ti, and Cr. The metal reflecting layer comprises at least one material selected from a material group consisting of In, Sn, Al, Au, Pt, Zn, Ag, Pb, Pd, Ge, Cu, AuBe, AuGe, Ni, PbSn, and AuZn. The nitride first cladding layer comprises at least one material selected from a material group consisting of AlN, GaN, AlGaN, InGaN, and

AlInGaN. The nitride light-emitting layer comprises at least one material selected from a material group consisting of GaN, InGaN, and AlInGaN. The nitride second cladding layer comprises at least one material selected from a material group consisting of AlNGaN, GaN, AlGaN, InGaN, and AlInGaN. The nitride first contact layer or the nitride second contact layer comprises at least one material selected from a material group consisting of GaN, InGaN, and AlGaN. The transparent conductive layer comprises at least one material selected from a material group consisting of indium tin oxide, cadmium tin oxide, antimony tin oxide, zinc oxide, and zinc tin oxide.

[0010] These and other objectives of the claimed invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

Brief Description of Drawings

[0011] Fig.1is a side view of a nitride light-emitting device having an adhesive reflecting layer of a preferred embodiment according to the present invention.

[0012] Fig.2is a side view of a nitride light-emitting device having an adhesive reflecting layer of another preferred embodi-

ment according to the present invention.

[0013] Fig.3is a side view of a nitride light-emitting device having an adhesive reflecting layer of another preferred embodiment according to the present invention.

[0014] Fig.4is a side view of a nitride light-emitting device having an adhesive reflecting layer of another preferred embodiment according to the present invention.

[0015] Fig.5is a side view of a nitride light-emitting device having an adhesive reflecting layer of another preferred embodiment according to the present invention.

DETAILED DESCRIPTION

[0016] Please refer to Fig.1. Fig.1 is a side view of a nitride light-emitting device 1 with an adhesive reflecting layer of a preferred embodiment according to the present invention. The nitride light-emitting device 1 comprises a first substrate 10, a metal reflecting layer 11 formed on the first substrate 10, a first reaction layer 120 formed on the metal reflecting layer 11, a transparent adhesive layer 121 formed on the first reaction layer 120, a second reaction layer 122 formed on the transparent adhesive layer 121, a second substrate 13 formed on the second reaction layer 122, a nitride first contact layer 14 formed on the second substrate 13 wherein an upper surface of the nitride first

contact layer 14 has a first section and a second section, a nitride first cladding layer 150 formed on the first section, a nitride light-emitting layer 151 formed on the nitride first cladding layer 150, a nitride second cladding layer 152 formed on the nitride light-emitting layer 151, a nitride second contact layer 16 formed on the nitride second cladding layer 152, a first electrode 17 formed on the second section, and a second electrode 18 formed on the nitride second contact layer 16.

[0017] Please refer to Fig.2. Fig.2 is a side view of a nitride light-emitting device 2 with an adhesive reflecting layer of another preferred embodiment according to the present invention. The structure of the nitride light-emitting device 2 is similar to the nitride light-emitting device 1 in the former preferred embodiment. The difference is that the first substrate 10 in the former preferred embodiment is replaced with a metal heat sink 20 so that the light-emitting device 2 can conduct heat fast.

[0018] Please refer to Fig.3. Fig.3 is a side view of a nitride light-emitting device 3 with an adhesive reflecting layer of another preferred embodiment according to the present invention. The difference between the light-emitting device 1 and the light-emitting device 3 is that the first substrate

10 of the light-emitting device 1 is removed in the light-emitting device 3.

[0019] Please refer to Fig.4. Fig.4 is a side view of a nitride light-emitting device 4 with an adhesive reflecting layer of another preferred embodiment according to the present invention. The nitride light-emitting device 4 comprises a first substrate 40, a metal reflecting layer 41 formed on the first substrate 40, a first reaction layer 420 formed on the metal reflecting layer 41, a transparent adhesive layer 421 formed on the first reaction layer 420, a second reaction layer 422 formed on the transparent adhesive layer 421, a transparent conductive layer 43 formed on the second reaction layer 422 wherein an upper surface of the transparent conductive layer 43 has a first section and a second section, a nitride first contact layer 44 formed on the first section, a nitride first cladding layer 450 formed on the nitride first contact layer 44, a nitride light-emitting layer 451 formed on the nitride first cladding layer 450, a nitride second cladding layer 452 formed on the nitride light-emitting layer 451, a nitride second contact layer 46 formed on the nitride second cladding layer 452, a first electrode 47 formed on the second section, and a second electrode 48 formed on the nitride second

contact layer 46.

[0020] Please refer to Fig.5. Fig.5 is a side view of a nitride light-emitting device 5 with an adhesive reflecting layer of another preferred embodiment according to the present invention. The nitride light-emitting device 5 comprises a metal heat sink 501, a first substrate 50 formed on the metal heat sink 501, a metal reflecting layer 51 formed on the first substrate 50, a first reaction layer 520 formed on the metal reflecting layer 51, a transparent adhesive layer 521 formed on the first reaction layer 520, a second reaction layer 522 formed on the transparent adhesive layer 521, a transparent conductive layer 53 formed on the second reaction layer 522 wherein an upper surface of the transparent conductive layer 53 has a first section and a second section, a nitride first contact layer 54 formed on the first section, a nitride first cladding layer 550 formed on the nitride first contact layer 54, a nitride light-emitting layer 551 formed on the nitride first cladding layer 550, a nitride second cladding layer 552 formed on the nitride light-emitting layer 551, a nitride second contact layer 56 formed on the nitride second cladding layer 552, a first electrode 57 formed on the second section, and a second electrode 58 formed on the nitride second

contact layer 56.

[0021] In each said preferred embodiment, a transparent conductive layer can be formed on the nitride second contact layer and under the second electrode to be an ohmic contact layer and a current distribution layer.

[0022] The first substrate 10, 40, 50 comprises at least one material selected from a material group consisting of silicon, GaAs, glass, quartz, GaP, GaAsP, AlGaAs, and metal, or other substitute materials. The second substrate 13 comprises at least one material selected from a material group consisting of Al_2O_3, SiC, ZnO, and GaN. The transparent adhesive layer 121, 421, 521 comprises at least one material selected from a material group consisting of PI, BCB, and PFCB. The first reaction layer 120, 420, 520 comprises at least one material selected from a material group consisting of SiNx, Ti, and Cr. The second reaction layer 122, 422, 522 comprises at least one material selected from a material group consisting of SiNx, Ti, and Cr. The metal heat sink 20, 501 comprises at least one material selected from a material group consisting of Sn, Al, Au, Pt, Zn, Ag, Pb, Pd, Ge, Cu, AuBe, AuGe, ni, PbSn, and AuZn, or other substitute materials. The metal reflecting layer 11, 41, 51 comprises at least one material selected from a

material group consisting of In, Sn, Al, Au, Pt, Zn, Ag, Pb, Pd, Ge, Cu, AuBe, AuGe, Ni, PbSn, and AuZn. The nitride first cladding layer 150, 450, 550 comprises at least one material selected from a material group consisting of AlN, GaN, AlGaN, InGaN, and AlInGaN. The nitride light-emitting layer 151, 451, 551 comprises at least one material selected from a material group consisting of GaN, InGaN, and AlInGaN. The nitride second cladding layer 152, 452, 552 comprises at least one material selected from a material group consisting of AlNGaN, GaN, AlGaN, InGaN, and AlInGaN. In addition, the nitride first contact layer 14, 44, 54 or the nitride second contact layer 16, 46, 56can comprise at least one material selected from a material group consisting of GaN, InGaN, and AlGaN. The transparent conductive layer 43, 53 comprises at least one material selected from a material group consisting of indium tin oxide, cadmium tin oxide, antimony tin oxide, zinc oxide, and zinc tin oxide.

[0023] Those skilled in the art will readily observe that numerous modifications and alterations of the device may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.